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Interactive Multimedia Development with CSCL Learning Strategy Assisted by Concept Map for Concept Understanding of Elementary School Students

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Abstract:

Elementary School students are Alpha generation children who understand technology. With today's increasingly rapid technological developments, concept maps can be used to support learning with computer technology by utilizing the CSCL model so that students can interact and collaborate anytime and anywhere online. For this reason, interactive multimedia development was carried out with CSCL learning strategies assisted by Concept Map for concept understanding of elementary school students. This development research aims to produce interactive multimedia to improve the understanding of grade 5 elementary school students in aspects of knowledge, skills, and attitudes. We use the Lee & Owens model to test the product's feasibility. In addition, to determine the improvement in learning outcomes of grade 5 elementary school students, an N-Gain Score normality test and a hypothesis test were carried out using paired sample t-test on pretest and post-test value data. The developed product is interactive multimedia with CSCL learning strategies assisted by Concept Map, and it is equipped with content in the form of reading materials, learning videos, and evaluation tests. The results of interactive multimedia validation produce excellent criteria based on material aspects, learning media aspects, and learning design. The response of grade 5 elementary school students received excellent criteria for the feasibility of multimedia learning as a learning medium. Based on the results of statistical tests, it was concluded that there was an increase in learning outcomes after using interactive multimedia with CSCL learning strategies assisted by Concept Map.

Keywords: *Concept map, CSCL, Interactive multimedia.*

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Introduction

New ideas in Indonesia's education world have grown rapidly and modernly and integrated with technological developments. Developments in the field of education in terms of technology are carried out to increase the quality of learning. Learning media as a tool is an innovation from development (Nikolawatin, et al., 2019). The tools used in the learning process are different and adjusted to student characteristics to attract student learning interest (Suminar, 2019).

According to Sadiman (2010:7), learning media is everything used to channel a message to the recipient, whose purpose is to stimulate students' thoughts, feelings, attention, and interest so that the teaching and learning process occurs. In conclusion, learning media benefits teachers in delivering learning material and is compelling enough to increase student learning motivation. Arsyad (2014: 19) stated that using learning media in the teaching and learning process can generate new desires and interests, generate motivation, stimulate learning activities, and even bring psychological influences on students.

From the explanation of the benefits of interactive multimedia as a learning medium, it is necessary to make interactive multimedia development containing reading materials, learning videos, and evaluation tests. Nazir et al. (2012: 820) stated that using multimedia in a teaching and learning environment can support students to become fast-learning critical thinkers, can solve problems, be suitable for finding information, and can further motivate their learning process. A lack of learning design can lead to a low learning environment.

The ability to understand material concepts in elementary school-level subject matter is meager, and students lack knowledge because they are now a digitally native generation, so it is easier to learn with interactive learning media than just with theory, lectures, and assignments. Lack of interest in student learning in exploring conventional learning material because of teacher-centered learning, where the teacher's role controls the learning process in class or the lecture method. Innovation in classroom learning is interactive multimedia because it attracts students to independent learning. In his research, Leow (2014: 105) revealed that 87% of students agree that video clips can help students get realistic information. In comparison, 77.4% of students agree that media can deepen their understanding. In this journal, students state that they do not need to spend much time reading because animation and pictures can help them understand the lesson. Multimedia can help you learn faster than the people who teach it.

Interactive multimedia as a learning medium is expected to motivate students because it is equipped with reading materials, motion animations, learning videos, and evaluation tests to make learning more serviced, practical, and engaging. The development of interactive multimedia is expected to be a solution in the learning process for students because this interactive multimedia is equipped with reading materials, learning videos, and evaluation tests.

However, using computers in interactive multimedia learning is often individual and does not precipitate collaboration. On the other hand, in learning, social interaction and collaboration are essential in determining the success of learning, as stated by Vygotsky, that learning is a shared joint process in a responsive social context (Wangsa et al., 2021). Therefore, a framework called Computer Supported Collaborative Learning emerged along with technological developments such as computer networks and the internet.

Computers not only function as learning media, but they can motivate and accelerate student learning. CSCL learning is student-centered and combines collaborative learning, computers, and the internet as a medium for learning. CSCL is a renewal of computer technology as a learning model because of its low cost. CSCL utilizes computer technology and can interact wherever and whenever created by teachers to create conditions for investigation and dialogue (Stahl, 2008). With CSCL, students can interact without limited space and time to support students learning effectively. Over the years, researchers have found evidence stating this learning strategy's effectiveness in various domains (Jeong et al., 2019).

Various approaches can be taken in developing computer-based learning, including a concept map (Farrokhnia et al., 2019). There are several advantages of using concept maps to improve the quality of learning. Ausubel et al. (1978) argued that regarding concept map theory, the benefits of meaningful learning for students are that information learned is easier to remember and new information that students receive facilitates the following learning process. In developing research with a learning model equipped with innovation with this concept map feature, students can use it to summarize a subject matter and provide effective and efficient solutions to understand new material. Concept maps can bring authentic ideas to life and make memory much more manageable than traditional note-taking. Several studies have shown that concept maps are very effective in applying such as improving learning outcomes (Ferry, 2022; Sari et al., 2019), critical thinking skills (Chen & Hwang, 2019; Alwafi, 2023), conceptual understanding and knowledge construction (Farrokhnia et al., 2019).

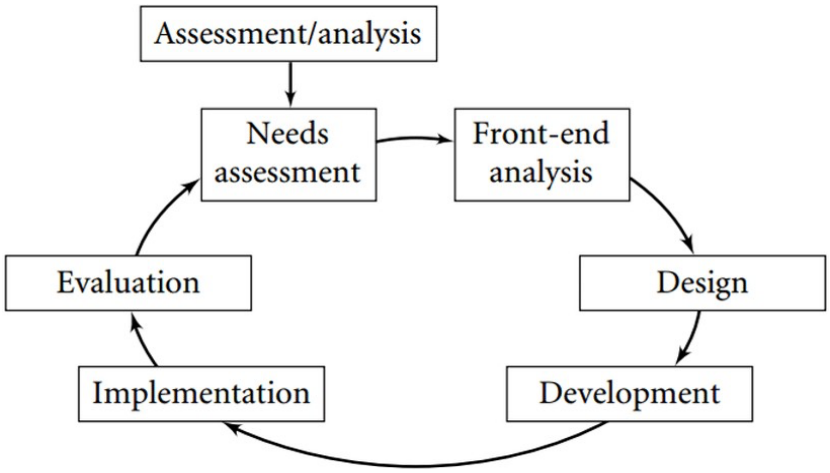
Based on identifying the above problems, the researcher intends to develop interactive multimedia with CSCL learning strategies assisted by concept maps to achieve students' cognitive dimension abilities.

Research Method

Effective research must be aligned between the methods applied and the development products produced. The result of this study is interactive multimedia with CSCL learning strategies assisted by concept maps. This interactive multimedia development uses Lee & Owens Development Stages (Lee & Owens, 2004), as seen in Figure 1.

The data types used in this development research are 1) Quantitative data, which can be measured, given numerical values, and calculated. This data is the result of validation questionnaires and student assessment questionnaires. 2) Qualitative data, the type of data that can be observed and recorded, is non-numeric. This data results from questions and answers with teachers, observations in schools, and comments from validators on the product's effectiveness.

Figure 1. Lee & Owens Development Stages



Experts carried out data processing of interactive multimedia validation results: 1)Material expert validators involving Malang State University Elementary School Teacher Education lecturers; 2) Learning media expert validators involving Malang State University lecturers who have competence in the field of CSCL learning strategies and Information and Communication Technology; 3) Learning design expert validators involving Malang State University lecturers who have competence in component areas Learning.

At the same time, the field trial involved grade 5 students of Ketawanggede State Elementary School Malang City. Products were tested using a validation questionnaire instrument with a four-choice Likert scale. According to Mulyatinigsih (2013: 29), a four-choice Likert scale was used to obtain firm or unhesitant answers from respondents. In developing this interactive multimedia, quantitative data results from validation by material experts, learning media experts, learning design experts, and students.

Effectiveness data analysis was conducted to determine whether there was an increased understanding of grade 5 elementary school students after participating in interactive multimedia learning trials with CSCL learning strategies assisted by Concept Map by comparing the average initial or pretest assessment data and final test or posttest assessment data. The analysis of Pretest and post-test data used is the N-Gain Score normality test, Kolmogorov-Smirnov normality test, and paired sample t-test for the hypothesis test. Data interpretation is carried out using the SPSS test theory, while conclusion-making refers to the interpretation of results. To measure the increase in student knowledge if there is a significant difference between pre-test and post-test scores. The effectiveness of learning can be measured, one of which is by testing student learning outcomes (Degeng, 2013). Details of the data collection method in Lee & Owens Development Stages are presented in Table 1.

Result and Discussion

Result

The results of this development research are in the form of interactive multimedia with CSCL learning strategies assisted by Concept Map for the understanding of elementary school students. The analysis is an important and earliest part of interactive multimedia development activities. The approach used in the analysis is, 1) Need assessment, this stage is a complete data collection stage that is used as material to develop products. Data were collected by conducting questions and answers with teachers and observations in the school environment of Ketawanggede State Elementary School Malang City to find out the needs of schools related to interactive multimedia development and what they need from a learning media, and 2) Front-end analysis, this stage is a stage to obtain complete data related to what will be developed, including participant analysis, technology analysis, situation analysis, task analysis, issue analysis, important event analysis, goal analysis, media analysis, data analysis, cost analysis.

The second stage is design, researchers design the arrangement and specifications of the product to be developed, design the material to be developed in the product, make storyboards serve as guidelines in the process of making interactive multimedia, and prepare the tools needed in the research and development process carried out. Figure 2 shows a use case diagram for CSCL learning development design assisted by a concept map.

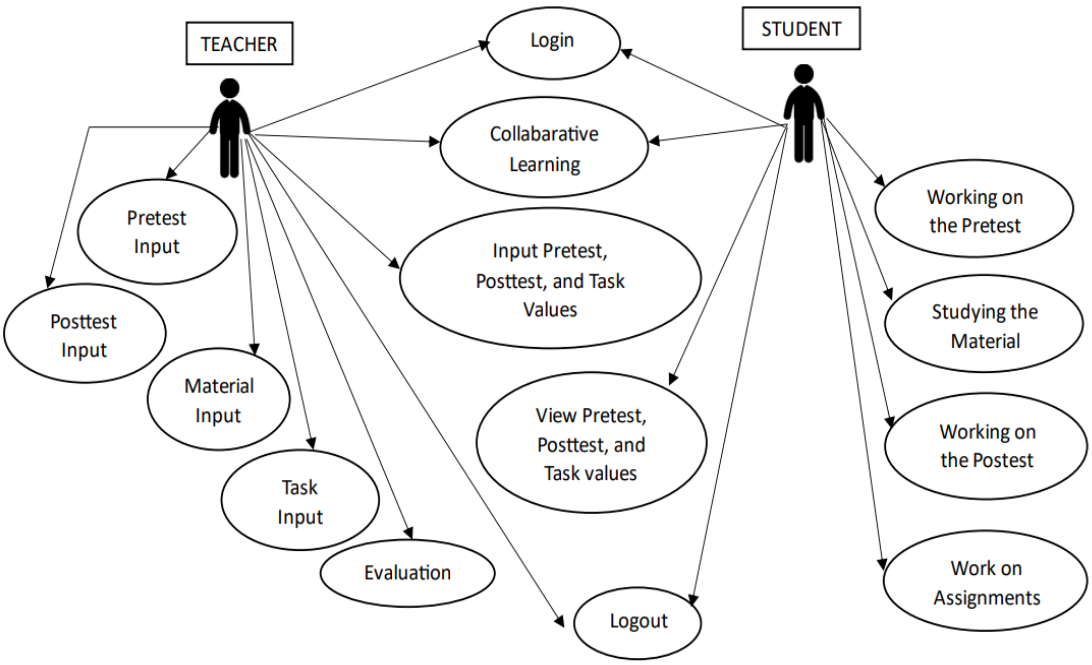
Table 1. Data Collection Method in Lee & Owens Development Stages

No.	Stages	Indicators	Instruments	Technique	Subject
1	Analysis Phase				
	Need Assessment	Researchers conducted data collection techniques with grade 5 teachers through interviews and observations at Ketawanggede State Elementary School in Malang City.			
	Front-End Analysis	Researchers analyze to get complete data related to what will be developed.	interview Form Observation Form	interviews and observations	Teacher, Children, School Environmental Conditions
2	Design Phase	Researchers design the arrangement and specifications of the product to be developed, design the material to be developed in the product, make storyboards that serve as guidelines in the process of making interactive multimedia, and prepare the tools needed in the research and development process carried out.	curriculum, syllabus, theme books, student worksheets software	Preparation of learning material Create a storyboard. Setting up the necessary software	
3	Development Phase	Researchers run each design obtained from the design stage in the form of interactive multimedia products.	storyboard software	Create and develop interactive multimedia designs.	
4	Implementation Phase	Product validation and testing tests are carried out.	Material Expert Validation Questionnaire Learning media expert	Validation results and product trial results.	Validators and students.
			Validation questionnaire Learning design expert validation questionnaire Student questionnaire Product Trials		
5	Evaluation Phase	Evaluation as a reference to improve the product.	Student validation and assessment results		

The CSCL scheme based on the Use Case Diagram above can be explained that teachers and students collaborate in learning. The function of the concept map is the clarity of ideas in learning for teachers and makes it easier for students to remember information in learning. The purpose of the concept map is that the notes made by students form a pattern that is interrelated and related to future science so that there is a well-organized understanding of student concepts.

Thus, interactive multimedia with CSCL learning strategies assisted by concept maps is very appropriate because it is very practical to apply to computer technology. With the help of concept maps, students copy subject matter more fluently and are instruments for brainstorming. Another advantage of concept maps is that they support learning because many images be used for assignments and presentations, and can improve students' critical thinking skills. Below are the results of interactive multimedia development products with CSCL learning strategies assisted by concept maps.

Figure 2. CSCL Schema with UML Diagram (Use Case Diagram)



The third stage is the product development stage. At this stage, researchers run every design obtained from the design stage in the form of interactive multimedia products. This stage includes the development of display designs that will be used in the product, the development of content that will be presented in the product, making the necessary improvements so that the product can be judged worthy of being implemented in the learning process, and the last is finishing the product in the form of interactive multimedia applications. In this case, the researcher uses Laravel framework version 9, PHP programming language version 8.1, and MYSQL database. Laravel Framework is a framework that can make web development faster, safer, and more practical because it is open-source with PHP and contains many basic modules to optimize PHP performance in web application development (Awaludin, 2016). The result at this stage of development is interactive multimedia complete with structured content as shown in Figure 3.

The fourth stage is implementation. At this stage, validation is carried out by material experts, learning media experts, and learning design experts to obtain assessments and determine the feasibility, practicality, and attractiveness of the product before being tested in learning activities. The validation process by these experts is carried out in two stages before the improvement and after the improvement according to the advice given by the validator. After the product is declared feasible, then the product is tested by students in the process of learning activities.

The fifth stage is the evaluation stage. At this stage, it is a reference to improve the product and also to assess the feasibility of interactive multimedia based on each stage or procedure that has been carried out.

The results of validation on the learning aspect by material experts consist of 16 questions obtained a total value of 61 points with a maximum value of 64 points so that they obtain a score of 95.31%. So that the results presented in Table 2 with an average of 95.31% were obtained.

Figure 3. Interactive Multimedia Login Display with CSCL Learning Strategy Assisted by Concept Map

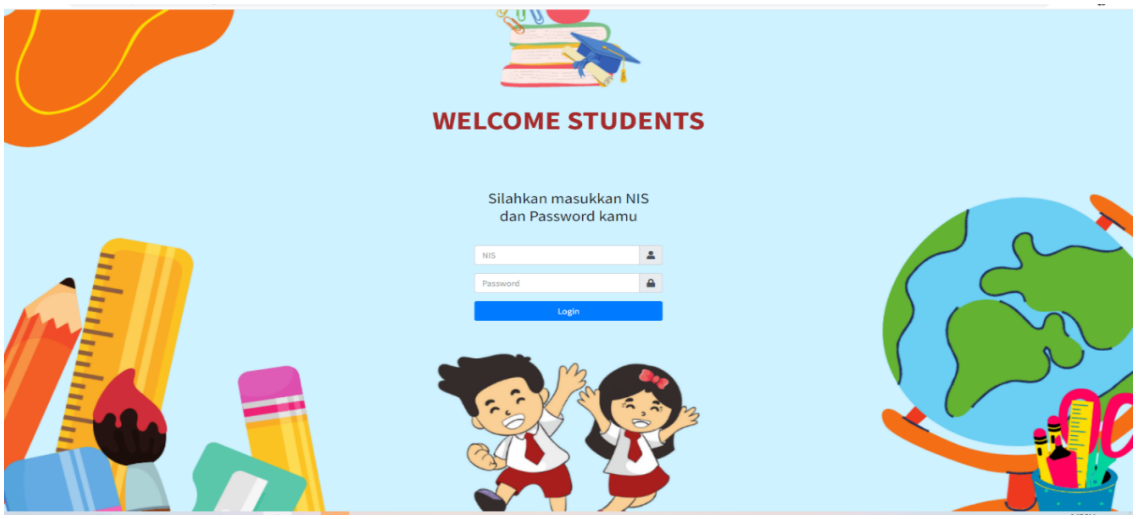


Table 2. Material Expert Validation Results

No	Assessment Aspect	Score	Information
1	Learning	95,31%	Excellent
	Average	95,31%	Excellent

The results of the validation of learning media experts, in the aspect of the application function consisting of 10 questions, obtained a total value of 37 points with a maximum value of 40 points and obtained a score of 92.5%. And in the aspect of the application display consisting of 5 questions, a total value of 17 points was obtained with a maximum value of 20 points so a score of 87.5% was obtained. The results of data processing from the learning media expert test with the two aspects above obtained very good results with an average of 90% can be seen in Table 3.

Table 3. Learning Media Expert Validation Results

No	Assessment Aspect	Score	Information
1	Application Functions	92,5%	Excellent
2	Application Display	87,5%	Excellent
	Average	90%	Excellent

The results of the validation of learning design experts, in the learning aspect consisting of 11 questions, obtained a total value of 44 points with a maximum value of 44 points and obtained a value of 100%. And in the aspect of learning evaluation consisting of 5 questions, a total value of 20 points is obtained with a maximum value of 20 points so that a value of 100% is obtained. The results of data processing from the expert test of learning design with the two aspects above obtained very good results presented in Table 4 with an average of 100% so it is worth testing.

Table 4. Learning Design Expert Validation Results

No	Assessment Aspect	Score	Information
1	Learning	100%	Excellent
2	Learning Evaluation	100%	Excellent
	Average	100%	Excellent

Furthermore, after being validated by experts, trials were conducted to determine student responses after using interactive multimedia. The trial was conducted on 23 grade 5 elementary school students and obtained an average score of 93.72%, meaning that this interactive multimedia has excellent results. Details of scores from two aspects of assessment, namely the application display and learning aspects, can be seen in Table 5.

Table 5. Product Trial Results

No	Assessment Aspect	Score	Information
1	Application Display	94,02%	Excellent
2	Learning	93,47%	Excellent
	Average	93,72%	Excellent

The N-Gain normality test is conducted to measure the effectiveness of learning outcomes in encouraging understanding of concepts before and after learning. From the results of the N-Gain normality test in Table 6, N-Gain criteria = 0.6 and N-Gain effectiveness = 65% interpretation, including N-Gain moderate criteria and quite effective interpretation. In conclusion, the use of interactive multimedia with CSCL learning strategies assisted by concept maps is quite effective in improving learning outcomes.

Table 6. N-Gain Normality Test Results

	N	Minimum	Maximum	Mean	Std. Deviation
N-GAIN	23	.43	1.00	.6517	.16542
N-GAIN_PERCENT	23	42.86	100.00	65.1704	16.54205
Valid N (listwise)	23				

Furthermore, the Kolmogorov-Smirnov normality test is carried out as a requirement for the T-Test is normally distributed data. Figure 4 shows the results of the Kolmogorov-Smirnov normality test.

Based on the results of SPSS data processing as shown in figure 5. It can be concluded that the data on the paired samples statistics test obtained the average pretest is 50.65, while the average posttest is 81.96. Data in the paired samples correlation test obtained a sig value. 0.00 < 0.05, it can be concluded that there is a relationship between pretest scores and posttest scores. After the paired sample t-test was obtained, the output was obtained with the results of Sig. 0.00 < 0.05, meaning that H0 was rejected and H1 was accepted. So it can be concluded that the pretest score is lower than the post-test score, and there is an increase in student achievement with the CSCL learning strategy assisted by Concept Map.

Figure 4. Kolmogorov-Smirnov Test Result using SPSS

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
PRETEST	23	100.0%	0	0.0%	23	100.0%
POSTEST	23	100.0%	0	0.0%	23	100.0%

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
PRETEST	.120	23	.200*	.947	23	.258
POSTEST	.159	23	.135	.919	23	.063

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Figure 5. Paired Sample t-Test Result using SPSS

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	PRETEST	50.65	23	14.326	2.987
	POSTEST	81.96	23	9.503	1.982

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	PRETEST & POSTEST	23	.716	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	PRETEST - POSTEST	-31.304	10.025	2.090	-35.639	-26.969	-14.976	22	.000

Discussion

The implementation of interactive multimedia with CSCL learning strategies assisted by this concept map is a web-based application that can be used by students as learning media and can see reading materials, learning videos, and learning evaluations. This interactive multimedia can be accessed via mobile phones, personal computers, and laptops, and be done anywhere and anytime with stable internet access. At the time of the development of interactive multimedia, several revisions have been made related to the layout of writing, images, learning media design, and learning features so that interactive multimedia is attractive and user-friendly to increase interest and facilitate users in accessing the learning process. Interactive multimedia with CSCL learning strategies assisted by concept maps must be designed and built because, without a digital learning environment provided, students tend to search for information through search engines or social media that provide more information outside the context sought so that it can shift the focus of student learning. This interactive multimedia also allows for student communication and collaboration in learning. The choice of the web as an interactive multimedia platform with CSCL is very suitable, where most CSCL implementations are applied to web-based digital learning environments (Safitri, et al., 2021).

Interactive multimedia with CSCL learning strategies assisted by concept maps must be designed and built, because, without a digital learning environment provided, students tend to search for information through search engines or social media that provide more information outside the context sought so that it can shift the focus of student learning. This interactive multimedia also allows for student communication and collaboration in learning.

The results of interactive multimedia validation developed with material expert test results of 95.31%, learning media expert test results of 90%, and learning design test results of 100%. Based on field trials, the response of grade 5 elementary school students with an average percentage of 93.72% means that this CSCL learning strategy assisted by a concept map is feasible, practical, and interesting as a learning medium.

To determine the increase in the achievement of the cognitive domain of elementary school students, a field trial study was conducted with the N-Gain normality test and the T-Paired Sample T-Test hypothesis test. In the N-Gain normality test, N-Gain criteria = 0.6 and N-Gain = 65% interpretation, including N-Gain criteria are moderate and interpretation is quite effective. In conclusion, the use of interactive multimedia with CSCL learning strategies assisted by concept maps is quite effective in increasing students' understanding of concepts so that there is an increase in student learning outcomes. Test the hypothesis of the Paired Sample T-Test on pre-test and post-test value data, with the results of Sig. (0.00) < (0.05), meaning that H0 is rejected and H1 is accepted. The conclusion is that the pre-test score is lower than the post-test score, so the conclusion is that there is an increase in the achievement of the cognitive domain of elementary school students after using CSCL learning strategies assisted by concept maps.

These interactive multimedia is designed to be flexible with the development of content and student needs according to the subject matter taught. Even so, subjects can still develop according to user needs because the system and database are designed to be able to add subjects according to the curriculum used. This flexibility is very important in learning in the 21st century because of the characteristics of students who have the ability to gather information faster than before (Joan, 2013).

Material experts responded that these interactive multimedia has presented subjects that are quite adequate and by the learning curriculum, but need to be improved again by developing and complementing contextual learning videos needed by students. In addition, the expectations of material experts are further enhanced for other features from various online learning resources to enrich the substance of the learning content and the interior of the material. Other research shows that digital technology in various forms can help change student learning from passive to interactive (Hu, 2021) which directly improves the quality of learning.

Learning that occurs also allows ubiquitous access and includes various models of learning activities. Thus, naturally, this learning applies the CSCL Learning strategy assisted by Concept Map. The concept of CSCL learning strategy assisted by Concept Map does not require a classroom as something important. Students are not required to attend regular times. Missing learning sessions doesn't cause any problem because students can study at different times. Dialogue or discussion can be carried out at any time, knowing no time, because ideas can arise at any time. This is in accordance with the principle of flexibility in online learning (Veletsianos, 2019).

More over the CSCL learning strategy assisted by Concept Map offers an environment for online collaboration. Online collaborative tools can be used to facilitate interactions between students as well as to promote intra-group emotional support. Both of these aspects are directly related to effective collaborative learning. These communication tools facilitate teacher-student interactions, which are important for providing pedagogical guidance, assistance, and technical support, and they also promote social presence (Hernández-Sellés et al., 2019).

Conclusion

The conclusion of this development research resulted in a product in the form of interactive multimedia with CSCL learning strategies assisted by Concept Map for understanding the concepts of elementary school students which aim to help achieve the ability of the cognitive realm dimension of students, where the content is complete with reading materials, learning videos and evaluation tests (pretest, posttest and assignment). The results of interactive multimedia validation developed received an average percentage of material expert validation results = 95.31%, learning media expert validation results = 90%, and learning design expert validation results = 100%. Based on field trials, the response of grade 5 elementary school students with an average percentage of 93.72% means that this interactive multimedia has excellent criteria for eligibility as a learning medium.

In the N-Gain normality test, N-Gain criteria = 0.6 and N-Gain effectiveness = 65% interpretation, including N-Gain medium criteria and moderately effective interpretations. In conclusion, the use of interactive multimedia with CSCL learning strategies assisted by concept maps is quite effective in improving student learning outcomes.

While in the hypothesis test Paired Sample T-Test data pretest and posttest, with the results of Sig. (0.00) < (0.05), meaning that H0 is rejected and H1 is accepted. So it can be concluded that the pretest score is lower than the post-test score, and there is an increase in student learning outcomes after using the CSCL learning strategy assisted by Concept Map.

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